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ABSTRACT

The booklet is a guide for music teachers and administrators who wish to incorporate electronic music into the junior or senior high curriculum. It defines program objectives and suggests goals, teaching strategies, materials, and equipment. Reasons for teaching electronic music include its popularity with the younger generation, its capability to be a musical outlet for students with no formal music training, and its relationship to other disciplines such as physics, acoustics, and math. Among the objectives of this course outline are mastery of basic terms and manipulation skills for the tape recorder and the synthesizer. The majority of the guide includes four units, each containing specific instructional objectives, performance objectives, and class activities. Content covers properties of sound, the tape recorder, the synthesizer, and history and literature of electronic music. Activities include splicing, playing tape backwards, multi-dubbing, identifying waveforms, discriminating aurally between mid-range signals modulated by sub-audio, and composing music. Instructional strategies and activity sequence are suggested. Appendices offer a glossary of electronic music terms; annotated lists of 15 books, 21 articles, 50 records, five films, and six audiovisual kits; and a checklist of recommended equipment. (Author/AV)

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An Instructional Guide
Department of Curriculum and Instruction

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

# COURSE OF STUDY FOR ELECTRONIC MUSIC I

Electronic Music is not of tomorrow, but today. Now. Even as you read, composers rescue new segments of the human soundscape for the province of expression and meaning. Their efforts deserve the attention of every person teaching music. Their work belongs in every classroom.

*Music Educators Journal*
November 1968

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Rockville, Maryland

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Rockville, Maryland

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## PREFACE

Electronic Music is the unique sound of the present generation. It accompanies daily activities, at work or at play. Electronic music is an expression of the contemporary composer, whether it be music for the concert stage; popular music; or music for film, radio, and television. Today's youth are tuned to electronic sounds; and many listen to it, learn about it, experiment with it, and express themselves through it.

The *Course of Study for Electronic Music I* is designed to serve as a guide for music teachers and administrators who wish to incorporate electronic music into the curriculum. This document defines the objectives of such a program and provides suggested goals, teaching strategies, materials, and equipment.


## ACKNOWLEDGMENTS

This guide was prepared under the direction of Catherine A. Nadon, music coordinator, and written during the summers of 1974 and 1975 by C. Martin Staub and Bert L. Damron, music teachers in the Montgomery County Public Schools. The final draft was completed in the spring of 1977, by Sidney G. Mollard and Bert L. Damron, music coordinators.

## COURSE DESCRIPTION — ELECTRONIC MUSIC I — *PROGRAM OF STUDIES*

Electronic Music I — Grades 9, 10, 11, 12

| | | |
|---|---|---|
| 6600 | 1 year | 1 credit |
| 6605 | 1 semester | ½ credit |

This course deals with learning about the various components of electronic music including tape recorder technique, sound collection, and, when the hardware is available, synthesizer technique. Activities will lead students to develop compositional techniques and will culminate in creating and performing original compositions using available resources. Students will listen to representative examples from the literature and will focus on composers and their compositional techniques. Additionally, students will develop a facility to use the specialized vocabulary associated with electronic music.

Electronic Music I may be organized as a one- or two-semester course. At the end of Electronic Music I as a one-semester course, the student should be able to:

- demonstrate a mastery of basic terms associated with the properties of sound
- demonstrate a mastery of basic terms associated with the tape recorder and the synthesizer
- demonstrate skills in the manipulation of the tape recorder in creating sound compositions
- demonstrate skills in the manipulation of the synthesizer in creating sound compositions

At the end of Electronic Music I as a two-semester course, the student should be able to:

- identify representative stylistic characteristics and compositional techniques associated with the history and literature of electronic music
- demonstrate a mastery of an expanded repertoire of electronic music terminology
- demonstrate advanced skills in the manipulation of the tape recorder and the synthesizer

## COURSE DESCRIPTION — ELECTRONIC MUSIC II — *PROGRAM OF STUDIES*

Electronic Music II — Grades 10, 11, 12

| | | |
|---|---|---|
| 6610 | 1 year | 1 credit |
| 6615 | 1 semester | ½ credit |

(Prerequisite: Electronic Music I)

This course is designed as a continuation of Electronic Music I and may be presented as large group instruction or as independent study. Emphasis is upon laboratory activities and the development of compositional techniques. Additional activities include exploring a variety of notational systems, an in-depth examination of electronic music equipment, intensive research in the history and literature of the art, and an examination of the application of electronic music to commercial advertising, film, and television production.

Electronic Music II may be organized as a one- or two-semester course. At the end of Electronic Music II as a one-semester course, the student should be able to:

- demonstrate the skills and competencies acquired from Electronic Music I
- demonstrate the use of a variety of electronic music notational systems

- demonstrate the facility to create extended sound compositions, using a variety of formal design structures

At the end of Electronic Music as a two-semester course, the student should be able to:

- demonstrate a knowledge of the significant trends in the history and literature of electronic music, based on extensive research
- create descriptive sound compositions such as radio and television jingles, background music for film, and music to accompany school dramatic productions

INSTRUCTIONAL OBJECTIVES FOR ELECTRONIC MUSIC I

The student should be able to:

- demonstrate a mastery of basic terms associated with the properties of sound
- demonstrate a mastery of basic terms associated with the tape recorder and the synthesizer
- demonstrate skills in the manipulation of the tape recorder in creating sound compositions
- demonstrate skills in the manipulation of the synthesizer in creating sound compositions

## PREPARING FOR INSTRUCTION — AN OVERVIEW

### THE USE OF THIS GUIDE

The *Course of Study for Electronic Music I* is intended to be used primarily as the basis for a one- or two-semester elective course in Electronic Music. It is organized into four units: I. Properties of Sound; II. Introducing the Tape Recorder; III. Introducing the Synthesizer; and IV. History and Literature of Electronic Music. When presenting this course as a one-semester offering, it is suggested that only the first three units be used. If Electronic Music I is presented over a full year, it is suggested that the content of units I, II, and III be expanded and that Unit IV, History and Literature of Electronic Music, be added. A set of objectives is included for the one-semester course, with additional objectives for the two-semester format.

If time, space, and/or teaching personnel preclude the offering of such an elective, some of the material in this guide will be helpful in presenting a condensed instructional unit within existing elective courses such as Music History and Literature and Music I. The guide may also be a useful resource in adding an electronic music component to middle/junior high school general music.

### WHY ELECTRONIC MUSIC?

Teachers are often asked to explain or justify the need for any program that is new or different, especially when funds are needed to purchase expensive equipment or materials. The following discussion speaks to a rationale for electronic music.

Electronic music captures the interest and stirs the imagination of students at all grade levels. Young people of today's generation have grown up with electronic music and are accustomed to its sounds. It is a product of recent technological advances and is ideally suited for inclusion in the curriculum because it offers *immediacy* in composition and performance, and it utilizes contemporary sounds that students feel are unique to their generation.

Synthesizers are the new instruments of today's music, and young people identify with them. When synthesizers are used in the classroom, sophisticated experiments in sound can be realized, sound compositions can be recorded and charted, and arrangements can be performed either *live* or on tape.

Electronic music can provide creative musical outlet for students with little or no formal music training. It can help in developing aural discrimination and increased sensitivity to the use of sound in other art forms. Additionally, students can develop their creative potential through exploration and involvement in this new sound medium. Through this process, students learn about electronic music through listening, by experimenting with available equipment, and by creating individual or group compositions.

Finally, a study of electronic music can provide an understanding of the relationships that exist between the medium and other disciplines. By manipulating synthesizers and tape recorders, students have interface with the theories and specialized language of electronics, physics, acoustics, and mathematics. Additionally, students experience the same processes as do those professionals who use this technology as a selected medium for advertising and other commercial purposes.

### THE LANGUAGE OF ELECTRONIC MUSIC

A necessary part of music study deals with the use and understanding of terms and symbols unique to the art. Similarly, the study of electronics involves the use of words, phrases, and symbols not commonly used by musicians. A'though many electronic terms have their musical equivalents, the use of electronic language is preferred because of its specificity. At first, the experienced music teacher may feel somewhat uncomfortable talking about *frequency* (rather than pitch) or *amplitude* (rather than loudness). It is extremely important that both teacher and the students develop fluency in the use of electronic language. The glossary on page 33 should be helpful in developing this skill.

## STRATEGIES FOR INSTRUCTION

Instruction in electronic music can be a unique experience, especially when students are involved in a laboratory setting with electronic equipment. This "hands-on" approach is the most productive way of involving students in the instructional program. A great deal of planning must precede the operation of this elective because of the simultaneous use of different electronic equipment and the varying skill levels and interest of the class. To facilitate this planning, three classroom formats are presented as organizational models. These should be useful to the teacher in planning for optimum use of time, space, and materials, and in adapting instruction to various learning styles.

1. Formal Lecture/Listening Format

   The emphasis in this approach is upon the history and literature of electronic music. It is a useful approach within an existing course of general music, music history and literature, or basic musicianship. Possible activities may include:

   a) Listening to recordings of electronic music

   b) Researching the history and development of electronic music

   c) Discussing the compositional techniques used in electronic music

   d) Discussing the trends and future development of the genre

   This format is useful when electronic equipment (including tape recorders and synthesizers) is not available. In the absence of a "hands-on" approach, it is strongly recommended that a wide variety of activities be included, such as structured listening, structured comparisons, independent listening, reports, new recording critiques, and discussions on current events and performance practice.

2. Lab Format

   The emphasis of the Lab Format is on experimenting, performing, and creating with electronic equipment. An extensive amount of hardware is necessary, especially to accommodate the needs of a large class. This format is easily adapted for small group or individualized instruction. *Much preplanning and organization is necessary.*

   Possible activities may include:

   a) Studying the mechanics of the tape recorder, synthesizer, and other equipment

   b) Collecting various examples of environmental sounds on tape

   c) Altering the sound characteristics or prerecorded tapes through backward play, speed change, splicing, dubbing, etc.

   d) Manipulating a synthesizer to obtain various sounds

   e) Learning to combine synthesized sounds

   f) Creating sound compositions using the tape recorder and/or the synthesizer

   g) Evaluating student performances and compositions

. Modified Lab Format

This approach is useful when a moderate amount of hardware is available. It combines the Lab and Lecture/Listening formats in grouping the class into teams and rotating these teams through a series of learning centers or stations. By utilizing several centers, students are able to participate in a wide variety of electronic music activities including listening, creating, and performing. The following are examples of electronic music centers:

a) Listening Center: listening to records of electronic music; evaluating commercial recordings and student compositions

b) Tape Recorder Center: practicing tape techniques; collecting environmental sounds; creating sound compositions using the tape recorder

c) Media Center: listening to and viewing filmstrips, video tapes, and films dealing with electronic music

d) Synthesizer Center: practicing synthesizer techniques; composing and/or performing using the synthesizer

e) Research Center: reading about the history and development of electronic music; learning about composers, compositional techniques, new equipment, electronic music notation, etc.; creating written reports based on research

The teams rotate through the various stations, completing tasks or assignments. Teacher aides or student assistants are helpful in directing students from station to station and keeping them on task.

When writing a course description for this activity, it may be desirable to include the following: "Enrollment is limited by the availability of equipment." This is important if there is only one synthesizer in the school. Also, it may be desirable for the course description to include the following prerequisite: "Ability to work independently or in a small group."

## SOME IDEAS ON ACTIVITY SEQUENCE

1. Learning about the tape recorder has proven to be a good starting activity, especially since these instruments are available in larger quantities than synthesizers. *Speed change* is a good starter. Many students have operated tape recorders and have the necessary entry skills.

2. *Musique concrete* is the next suggested activity. Students can use their newly acquired tape recorder skills in creating short compositions using environmental sounds.

3. Using the synthesizer is an activity demanding higher level of skill development; having the necessary tape recorder skills is usually considered a prerequisite.

4. As the class learns about the early wire and tape experiments of the 1940's and 1950's, it is appropriate to involve students in lab experiments paralleling these processes. In this way, history can be more meaningful as the student applies to a real situation the theory learned in class. Because it is important to include both theory and practice as a part of any exploratory program, teachers are urged to involve their students as soon as possible with "hands-on" experiences outlined later in this guide. Historical and theoretical considerations, therefore, become outgrowths of real experience.

5. The teacher should schedule appropriate culminating activities such as a New Music forum or concert. Such concerts of electronic compositions may be performed for the class, the school, or as a public program for the community.

## ELECTRONIC MUSIC AT ALL LEVELS OF INSTRUCTION

Electronic music may be used by all teachers, not just those who have access to synthesizers and other sophisticated hardware. At the elementary level, recordings of electronic music compositions may be used for exploring the elements of form and texture and also as interesting sounds for creative movement. At the middle/junior high school, where "hands-on" is a necessity, students may collect, process, and organize sounds via tape recorder. In addition, they can be introduced to the synthesizer and can continue experiences with active, directed listening. As a culminating experience at the high school, elective courses offer a more sophisticated, in-depth approach to learning, with students creating, notating, and analyzing their own compositions. (Instrumental and choral teachers should note that there are many interesting possibilities available for combining taped electronic sounds with conventional performing ensembles.)

Finally, when the teachers within a feeder system or an instructional area plan their K-12 music curriculum, their total effort will be enriched if the medium of electronic music is included at all levels as a part of the ongoing, sequential program.

## I. PROPERTIES OF SOUND: A SUGGESTED UNIT

**INSTRUCTIONAL OBJECTIVE:** *The student should be able to demonstrate a mastery of basic terms associated with the properties of sound.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- identify and describe the various properties of periodic waveforms including sine wave, square wave, sawtooth wave, and pulse wave
- compare and contrast two different sounds in terms of frequency, amplitude, and waveform
- use the appropriate terminology with accuracy when talking about the various processes associated with recorded and synthesized sound

**Properties of Sound**

A. Introduction

In order to respond with perception to music, it is important to develop a functional literacy with the basic terms associated with the art. *Pitch, timbre,* and *loudness* are examples of those basic terms used to describe any sound.

More precise descriptors are needed, however, for the specialized area of electronic music. Thus, pitch is analogous to *frequency*; the electronic analog to timbre is *waveform*; and the degree of loudness of an electronic sound is referred to as *amplitude*.

These terms are listed below, defined, and accompanied by student activities. This format can be used by teachers to develop strategies for learning about other basic terms. (Each unit can be expanded in this manner.)

B. Electronic Music Terms and Activities

1. Frequency

That characteristic of a sound which makes it "high" or "low" is called *frequency*. Frequencies within the range of human hearing (those that are audible) can be referred to as *pitch*. An example of an audible frequency is "A-440" ("A" is the pitch name, while "440" indicates the number of vibrations per second). Most symphony orchestras tune to this pitch (sounded first by the oboe).

Range is also an important consideration when discussing frequency. The audible range of frequency for most people is 20-20,000 Hz. Anything below 20 Hz is called sub-audio, while those frequencies above 20,000 Hz are beyond most people's capability to hear.

Note that when the frequency of a pitch is doubled, a pitch one octave higher is sounded; and inversely, when a frequency is divided in half, a pitch one octave lower results.

a) Frequency Activities

(1) Borrow a variable oscillator from the science room and patch it into a Califone tape recorder. Use this device to determine the frequency of sounds produced on a variety of instruments.

(2) Using the variable oscillator, plot on a music staff the playable ranges of instruments. Try to do this with guitar, string bass, recorder, trumpet, human voice.

(3) Have students determine how high they can hear, again using the variable oscillator as a check.

(4) Experiment with the cello or guitar by halving the strings (pressing down midway between the ends). What happens to the sound?

(5) Have students develop their tonal memory for the frequency A-440 by checking it daily for two weeks. Have students keep a log of their accuracy in terms of approximate frequency. Indicate improvement on a graph.

(6) If two oscillators are available, have students match them to *exactly* the same frequency. Raise or lower the frequency on one of the oscillators slightly. Have students count the number of "beats" or pulses. What happens to the beats as the frequencies become closer? Discuss the term *vibrato*. Determine the number of beats or pulses per second for a "fast" or "slow" vibrato.

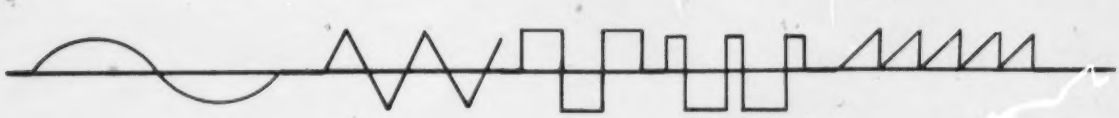
2. Waveform (Timbre)

*Timbre* is the quality of sound that differentiates between two instruments sounding the same pitch. Timbre is a result of the overtones or harmonics sounded above the fundamental pitch. Each instrument produces a different pattern of harmonics. This pattern is called a *waveform* and can be visualized and measured on an oscilloscope.

There are five basic waveforms that are important in electronic music. They are:

sine triangle square pulse sawtooth

They are represented on an oscilloscope as follows:



a) Waveform Activities

(1) Have the class members close their eyes. Drop a variety of objects on a table one by one, such as a ping-pong ball, a ceramic ash tray, a toy cymbal, a maraca, a tennis ball, paper clips, a ruler. Have students identify the object by its timbre. Can they name the construction or material of which the object is made?

(2) Demonstrate fundamental sound on various wind instruments.

(3) Demonstrate overtone series on wind instruments. List on staff paper and compare.

(4) Using an oscilloscope borrowed from the science room, demonstrate waveforms of sine wave and square wave. (Patch variable oscillator into the oscilloscope.) What instrumental sounds do these waveforms most closely resemble?

(5) Patch a microphone into the oscilloscope. Play a variety of instruments and chart the waveforms. Invite an automobile mechanic to class. Have the person describe or demonstrate how the oscilloscope is used in automotive repair.

3. Amplitude

***Amplitude*** **has two important aspects. The first is overall loudness, which can vary from a soft whisper to the blast of a rocket. The other aspect is the degree that the sound is sustained in time. Thus the *attack* or initial property of a sound, the steady rate or sustained quality of sound, and the release or decay of the sound are all important factors in talking about amplitude. Taken as a whole, these factors are called amplitude *envelope*.**

Consider three properties of an amplitude envelope:

| | |
|---|---|
| Attack time: | the period of time from silence to that moment when a sound reaches its maximum loudness |
| Sustain time: | a time period when the sound is maintained at same loudness level |
| Decay time: | the period when the sound fades away (During the final decay, the sound fades away to silence.) |

These variations in loudness are dynamic. The loudness can vary during the sound. Changes in timbre and pitch can also occur during a sound. Therefore, frequency (pitch) and waveform (timbre) can be enveloped as well as amplitude.

a) Amplitude Activities

(1) Divide the class into five parts, each part with a different musical instrument such as cymbal (with bow), slide whistle, recorder, guitar, piano, etc. The task is to discover five different ways of "playing" the instrument and thereby discover various *envelopes* of sound. Draw a picture of each of the five envelopes.

(2) Contact your principal and arrange to borrow a device used to test hearing. Have students determine the *lowest* amplitude they can hear. Chart the results.

(3) Discuss amplitude in terms of noise levels and decibels. Investigate the research regarding how the human ear is affected by noise. What is the threshold of pain? Are rock musicians adversely affected by the levels of sound they frequently experience?

(4) Using a VUE-meter on a tape recorder and a microphone, experiment with various levels of amplitude. Determine comfortable and uncomfortable sound levels and distances from sound resources.

C. Sample Assessment Techniques

1. Using a synthesizer, oscillator, and/or available instruments, construct a tape to be used to assess how well students identify sound characteristics by ear. There should be at least ten recorded examples, each five seconds in length. Each example should be separated by three seconds of leader. (See Sound Tape description below.)

Half of the sounds will be "pure" sine or square wave examples. The other half can be instrumental sounds. Students should respond to at least two characteristics of each example with at least 80 percent accuracy.

Sound Tape

| Waveform/Timbre | Frequency | Amplitude | Envelope (attack or release) |
|---|---|---|---|
| sine | low | high | n/a |
| square | low | low | n/a |
| sine | high | high | n/a |
| sine | low | low | n/a |
| square | high | high | n/a |
| flute | high | high | sharp attack |
| string bass (pizz) | low | high | sharp attack |
| oboe | low | high | sharp attack |
| trumpet (muted) | low | low | sharp release |
| cymbal | — | low-high | crescendo pp to ff |

2. Play a two-minute excerpt from an electronic music selection. (You may have to repeat it several times.) Have students respond to the selection in writing by describing the forms, combinations, and variations in waveform, frequency, and amplitude. For a variation, organize juries or review panels composed of four or five students each. The task is the same but verbal in nature. In each individual response, look for at least six descriptors regarding the three topics studied.

## II. INTRODUCING THE TAPE RECORDER: A SUGGESTED UNIT

**INSTRUCTIONAL OBJECTIVES:** *The student should be able to demonstrate a mastery of basic terms associated with the tape recorder.*

*The student should be able to demonstrate skills in the manipulation of the tape recorder in creating sound compositions.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- identify the parts of the tape recorder with accuracy
- demonstrate with accuracy the skills of re-recording, backwards play, sound-on-sound, sound-with-sound, speed change, and splicing
- create a 90-second tape sound composition, demonstrating stylistic and compositional characteristics of *musique concrete*

**The Tape Recorder**

A. History and Background of the Magnetic Recorder

1. Early experiments with acoustical recordings were done in the United States directly on discs and cylinders.
2. Magnetic tape recorders were created in Nazi Germany in the 1930's and reached a high point of development by the end of World War II.
3. Magnetic tape recorders became available to the public around 1948, although they had been marketed inside Germany since 1935.
4. The first concept of *musique concrete* appeared in France in 1948, followed by the first tape music, also in France in 1950. The first tape concert in the United States was performed in New York in 1952.
5. Stereo became commercially available in the mid-fifties, while quadraphonic sound, cassettes, and cartridge tape recorders were produced first in the sixties.
6. There are now three types of tape recorders on the market:

   a) *Reel-to-reel.* Recommended for electronic music classes due to its flexibility. Uses 2, 3, 4, or even more heads. Can feature reverse play, sound-on-sound, sound-with-sound, multi-track synchronization, over-dubbing, echo, speed change, etc. Tape speeds vary from 1 ⅞ ips to 15 ips.

   b) *Cassettes.* Best for portability; good for collecting environmental sounds; low in fidelity without a Dolby attachment; tape moves at a constant 1 ⅞ ips speed; tape is narrow and moderately inaccessible, making it difficult to splice.

   c) *Cartridge.* Usually found in eight-track configuration with four stereo or two quadraphonic programs running simultaneously on a continuous tape with movable heads to pick up any of the programs; found mainly in automobile stereo systems, most frequently as a player, not a recorder; the tape moves at a constant 3 ¾ ips.

B. Utilization of the Reel-to-Reel Tape Recorder

1. As a teaching aid

a) Place audio examples to be used in class on tape for handy use.

b) Tape can be played without losing eye contact with the class.

c) Compositions and productions can be recorded for analysis by teacher and class for performance.

d) A permanent tape library of past performances, compositions, and productions can be established.

e) Compositions can be played at a slower speed than originally intended, thereby giving the listener a better chance to "examine" the music.

2. For learning about recording techniques

a) Change of speed

(1) For resultant sound to be high and fast, record at a slower speed and play back at a faster speed.

(2) For resultant speed to be low and slow, record fast and play back slow.

b) Multi-dubbing

(1) When using monaural tape recorders, two machines must be used. Record first on one machine, play back, and add second sound to other machine. In this way, both first and second sounds will be recorded.

(2) When using a two-head stereo tape recorder, record first on channel A, then place channel A on Play and channel B on Record. While monitoring channel A, place second sound on channel B. When played back, both channels will give the sounds simultaneously (sound-with-sound).

(3) When using a three-head machine, record first on channel A. Place recorder in sound-on-sound mode, as per directions for that particular model, and record both sounds on channel B. These combined sounds can then be re-recorded on channel A while adding another sound, etc.

(4) When using a four-track "Simul-Sync" machine or its equivalent, follow step 2. However, four tracks can now be recorded instead of just two.

c) Playing tape backwards

(1) Equipment needed: two matched tape recorders, monaural, which have the heads activated in the play-pause function (such as the Rheem Califone Model 70 TF).

(2) Procedure:

(a) Place tape recorders side by side.

(b) The tape recorder on the right (RH-TR) faces you correct way; the tape recorder on the left (LH-TR), 180° backwards.

(c) Thread tape from LH-TR take-up reel hub to RH-TR take-up reel. Twist tape a half turn between machines, keeping dull side of tape against tape recorder heads.

(d) LH-TR is placed into play-pause mode, volume down. Volume remains down on this machine.

(e) Record with RH-TR normal way.

(f) Stop RH-TR and put into play-pause mode, volume up.

(g) Start LH-TR. Program will be heard backwards on RH-TR.

(3) Alternate procedure: A tape that is recorded on a monaural machine may also be played backward by turning the tape over and playing it in the opposite direction on a stereo tape recorder. The resultant sound will appear backward on one of the stereo channels. NOTE: There cannot be anything else on the tape other than that information which is to be played backward.

d) Tape loop production

One of the basic tape recording techniques of electronic music is the tape loop.

(1) Record the information on regular reel-to-reel taping set-up.

(2) Cut tape at the beginning and the end of the recorded information.

(3) Loop fragment around and splice together.

(4) On playing back, the reels are bypassed. Try to maintain a slight tension on the tape loop.

e) Splicing

(1) Equipment needed: splicer, splicing tape, razor blade

(2) Procedure:

(a) Cut both ends of tape at approximately a 45° angle.

(b) Place ends together. DO NOT OVERLAP.

(c) Affix splicing tape on non-magnetized side only.

(d) Trim edges.

## C. Sample Tasks for Tape Recorders

### INSTRUCTIONS TO STUDENTS:

All tasks should be done on monophonic recorders unless instructions call for multiple tracks. Use the type of tape intended for the machine you are using. Be certain you are recording on *your* assigned reel of tape. All tasks are to be prepared for a playback of 7 ½ inches per second. Announce your name, task number, and recorded excerpt. For example:

"Joe Doe, task number 2c, re-recording a recorded tape at twice the intended speed."

Start recording near the beginning of the tape or directly after your last recorded assignment. As you finish each task, fold the task sheet, place it inside the tape box, and turn boxed tape in to the instructor.

### SAMPLE TASK NO. 1 FOR TAPE RECORDERS

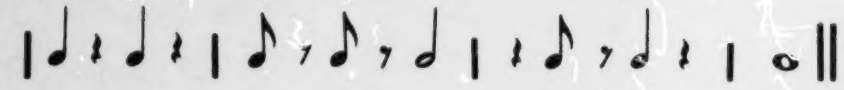
1. Splice 12 inches of leader tape to the beginning of the tape.
2. Record approximately one minute of recorded conversation, using the microphone.
3. Re-record (dub) approximately one minute of:
   a) a prerecorded tape (reel)
   b) a prerecorded tape (cassette)
   c) a phonograph recording
4. How many inches of tape will pass the record head in 25 seconds at the following speeds?
   a) 1 ⅞ ips
   b) 3 ¾ ips
   c) 7 ½ ips
   d) 15 ips

### SAMPLE TASK NO. 2 FOR TAPE RECORDERS

1. Re-record (dub) approximately one minute of a prerecorded tape:
   a) at twice the intended speed
   b) at half the intended speed
   c) using hand manipulation
2. Record at least 15 interesting natural or environmental sounds. Have a friend identify as many of the recorded sounds as possible. Change tape speed of the recorded sounds to see whether the friend can still identify the sound sources.
3. Using a separate reel of tape, produce your own tape loop of vocal or instrumental sounds. Dub your tape loop on your assigned reel of tape. Be certain that the loop is recorded several times.

## SAMPLE TASK NO. 3 FOR TAPE RECORDERS

Construct the following fragment at 7 ½ ips:



where:

1. each note represents a 440 Hz frequency
2. each rest represents a portion of leader tape
3. = 6 inches of tape

method:

1. Record a 440 Hz tone (using the synthesizer) on approximately 75 inches of tape at 7 ½ ips.
2. Cut the approximate number of eighth, quarter, half, and whole note strips from your recorded tape.
3. Cut the appropriate number of eighth and quarter rest strips from your reel of leader tape.
4. Splice sound and silence strips together.

Note:

= ½ of

= two times

= four times

and are the same duration

and are the same duration

## SAMPLE TASK NO. 4 FOR TAPE RECORDERS

1. Prepare a "sound-on-sound" tape, as follows:

   a) Record approximately two minutes of sharply defined repeated sounds made from a single sound source.

   b) After rewinding the tape, record a second sound (a sustained sound from a single source) "on top" of the first recording. Be certain you do not erase your first recording when making your second. (The erase head must be bypassed on the second recording.) For best balance, your second recording should be done at a lower level.

2. Prepare a "delay and echo" tape, as follows:

   Using two tape recorders, record on one tape recorder while the delayed playback (on the second tape recorder) is also being recorded on the first tape recorder.

## SAMPLE TASK NO. 5 FOR TAPE RECORDERS

1. Prepare "backwards sound" tapes, as follows:

   a) On another tape, dub approximately one minute of music followed by one minute of recorded conversation. Play the recorded segment backward while re-recording it on a second tape recorder (on your assigned reel of tape). Following your two-minute recording of "backwards sounds," dub the original recording (frontward).

   b) On another reel of tape, record a live performance of a piece of music played in reverse. (The player starts at the "end" of the music and plays to the "beginning.") Play the recorded segment backward while re-recording it on a second tape recorder (on your assigned reel of tape). Listen carefully to the resulting recording. Be able to explain why the tape does not sound "natural."

## SAMPLE TASK NO. 6 FOR TAPE RECORDERS

1. Prepare a *Musique Concrete* tape on a stereo tape recorder (sound-with-sound), as follows:

**Sounds**

| **Group A** | **Group B** | **Group C** | **Group D** |
|---|---|---|---|
| woodblock | strum piano strings | whistle | smack lips |
| tambourine | scrape metal guitar strings | hum | stomp feet |
| bells | | dried peas in can | clap hands |
| autoharp | play on mouthpiece of wind instrument | rub sandpaper | rustle paper |
| drums | strike case or frame of piano | plunk stretched rubber band | drip water |
| | | | slam door |

NOTE: With the approval of the teacher, you may substitute sounds of your choosing for those listed above.

Perform the following composition, using the sounds described above.

| Track A | Track B |
|---|---|
| • Short sounds from Group B for 40 seconds (medium soft) | • Sounds from Group D for 30 seconds |
| | • Rapidly repeated sounds from Group A for 35 seconds |
| • Group C sounds for 25 seconds with extreme changes in volume | |
| • Silence for 20 seconds | • Silence for 10 seconds, then loud Group B sounds for five seconds. Silence for 5 seconds |
| • One short staccato sound followed by silence for 13 seconds | • One short staccato sound followed by repeated Group C sounds becoming softer and softer, and gradually dying away (approximately 13 seconds) |

2. Be certain you do not erase one track while recording on the other. Announce sound sources at the end of your tape.

D. Sample Assessment Measures

One task assessment technique is to list the activities in the unit and weigh each according to time, degree of difficulty, class emphasis, etc.

| Activity | Quality Points |
|---|---|
| Tape activities: | |
| speed change | 5 |
| reverse play | 5 |
| backwards play | 15 |
| tape loop | 15 |
| feedback | 10 |
| filtering | 5 |
| splicing | 15 |
| sound-on-sound | 25 |
| sound-with-sound | 20 |
| dubbing | 10 |
| written identification of terms | 25 |
| TOTAL | 150 |

The teacher should place this list on a poster and display it at all times in the classroom. Include a grading scale on the poster:

**Grading Scale (sample)**

| | | |
|---|---|---|
| A | = | 135-150 points |
| B | = | 120-135 points |
| C | = | 110-120 points |
| D | = | 100-110 points |

## III. INTRODUCING THE SYNTHESIZER: A SUGGESTED UNIT

**INSTRUCTIONAL OBJECTIVE:** *Given the equipment, students will develop and demonstrate skills in the manipulation of the synthesizer in creating sound compositions.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- demonstrate skills in creating a 60-second taped sound composition, using a synthesizer
- demonstrate the skill of replicating and/or modifying a compositional technique
- demonstrate skills in creating a tape composition, using both synthesized and environmental sound sources
- demonstrate the skill of creating a reverberation effect on the tape recorder, using synthesized sound
- determine means of altering envelope characteristics such as attack, sustain, and decay
- replicate with accuracy the production techniques used on six (electronic) television commericals

**Introducing the Synthesizer**

A. History and Development

1. An electronic music synthesizer is a modular musical instrument capable of simulating conventional sounds and producing novel sounds. It is an electronic instrument designed for the production and control of sounds.

2. The first synthesizer was an RCA Synthesizer exhibited in 1956 by Harry F. Olson and Herbert Belar. RCA developed the Mark II Synthesizer in 1958. It was moved to the Columbia-Princeton Electronic Music Laboratory in 1959 and become an integral part of its operation. In 1964, a sound producing program was started at Bell Telephone Laboratories.

3. Transistorized portable and studio synthesizers began to appear in the mid-sixties with Moog, Buchla, and SynKet leading the way. ARP, Electro-Comp, Putney (Ionic Industries), and EML synthesizers are also available now. A comparison of the salient features of these instruments appears beginning on page 118 of *The New World of Electronic Music* by Walter Sear, Alfred Publishers, 1972.

B. Using the Synthesizer

1. Synthesizers generally come in two formats, studio and performance. The studio synthesizers are controlled by various knobs, pushbuttons, and external patchings to produce unique sounds and tone colors. They can also be used to modify existing sounds, live or prerecorded, with a keyboard not unlike that of a piano or organ. The keyboard gives the performer/composer a tremendous flexibility in terms of pitch, intervalic relationships, tonal shadings, enveloping of notes, etc. The major drawback is the fact that the synthesizer is capable of playing only one note at a time. To play polyphonic pieces, one must re-record either along-side or on top of what has already been recorded.

2. Each synthesizer model comes equipped with an extensive manual giving complete instructions on its operation together with suggested experiments designed to familiarize the user with the instrument by the use of "hands-on" time. It is suggested that the teacher study these manuals very thoroughly before using the synthesizer in an electronic music class. It is also suggested that the teacher experiment with the synthesizer before attempting demonstrations before the class!

## C. Sample Tasks

### 1. SAMPLE TASK NO. 1 FOR THE SYNTHESIZER

a) Identify four basic "modules" of the synthesizer. Explain each module's function.

b) Get a sound from the synthesizer. Explain (1) the sound source, (2) any electronic control of the signal, (3) any electronic modification of the signal. Be able to "trace" the path of the signal.

c) Demonstrate sawtooth, square, and sine waveforms. Be able to identify each from its graphic representation.

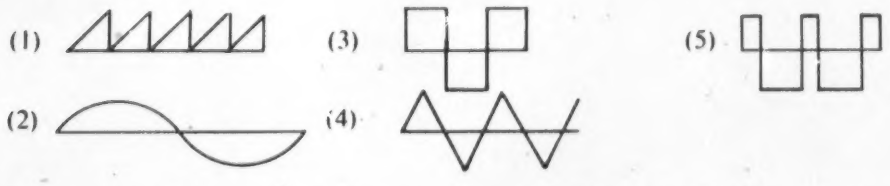
d) Tune two oscillators to a unison tone. (Tune to a unison tone by "zero-beating" the summed output.)

e) Be able to discriminate aurally between the sine and sawtooth wave signals.

f) Demonstrate getting "white noise" from the synthesizer.

### 2. SAMPLE TASK NO. 2 FOR THE SYNTHESIZER

a) Identify each of the following waveforms:




b) Demonstrate the use of the low-pass filter by gradually "filtering out" the overtones of a sawtooth wave. What finally happens to the tone when all of the overtones are filtered out?

c) Demonstrate tuning three oscillators to a musical chord. Demonstrate adding "reverb" to this chord.

d) Define and explain "white noise."

e) Demonstrate the use of the low-pass filter by gradually filtering white noise. What is "pink noise"?

### 3. SAMPLE TASK NO. 3 FOR THE SYNTHESIZER

a) Get a sound from the synthesizer. Draw a block diagram which shows the signal path of your sound.

b) Generate sub-audio sawtooth or square waves from each oscillator, where possible. Generate two sub-audio waves (sawtooth and square) of different frequencies to produce interesting "click" patterns.

c) Frequency Modulation:

(1) Demonstrate manual frequency modulation of a mid-range frequency.

(2) Demonstrate the use of a sub-audio frequency to modulate a mid-range frequency.

(3) Demonstrate the use of each sub-audio waveform (sine, square, sawtooth, etc.) to modulate a mid-range frequency. Listen carefully to each modulation.

d) Obtain "white noise." Demonstrate three different methods of producing an "ocean wave" effect.

4. SAMPLE TASK NO. 4 FOR THE SYNTHESIZER

a) Discriminate aurally between mid-range signals modulated by sub-audio:

1) Sine waves

2) Sawtooth waves

3) Pulse or square waves

b) What is frequency modulation? Demonstrate manual frequency modulation. Demonstrate voltage controlled frequency modulation.

c) What is amplitude modulation? Demonstrate manual amplitude modulation. Demonstrate voltage controlled amplitude modulation.

d) Demonstrate how a sub-audio square wave can be used to turn a mid-range signal "on and off." Also, demonstrate differences in the controlled VCA output by changing the signal frequency, the control frequency, and the gain setting of the VCA.

e) Demonstrate the use of two simultaneous sub-audio controls on the VCA. Draw a block diagram of this patch.

5. SAMPLE TASK NO. 5 FOR THE SYNTHESIZER

a) Demonstrate "playing" the oscillator with the keyboard unit. Demonstrate the use of the controls on your keyboard unit. Draw a patch diagram which includes the keyboard unit.

b) What is timbre modulation? Demonstrate manual timbre modulation. Demonstrate voltage controlled timbre modulation. Demonstrate three different waveforms (sub-audio) used to modulate the timbre of a mid-range frequency.

c) Demonstrate "setting up" the electric bass guitar patch given. Perform a suitable fragment.

d) Demonstrate the use of the Envelope Generator to control the VCA. Explain how different sounds can be achieved through different settings on the Envelope Generator (attack, release, etc.)

e) Demonstrate the use of the Envelope Generator to control the VCF. Explain how different sounds can be achieved by varying the settings on the Envelope Generator.

6. SAMPLE TASK NO. 6 FOR THE SYNTHESIZER

a) Develop your own original patch. Be able to explain EXACTLY WHAT DOES WHAT. Give it a name. Mark one of your panel sheets to indicate the exact patching. Draw a representative block diagram of the patch. Be prepared to demonstrate it to the class.

b) Produce a locomotive effect (turn white noise "on and off") by:

1) Manual operation of the attenuator in the Mixer or Noise Generator

2) Operation of the manual start button in the Envelope Generator

3) Operation of the Sample Hold Gate or Electronic switch in the Envelope Generator

4) Using keyboard voltage as a gate

5) Using a sub-audio signal as a control

c) Using the oscilloscope, demonstrate the filtering of a sawtooth wave until it becomes a sine wave. Then, demonstrate the addition of overtones (slowly — one at a time) until it resumes being a sawtooth wave. Be certain that each overtone is visible on the scope as it is being added.

D. Sample Assessment Measures

1. A student *log* will indicate progress on various tasks. The tasks may be listed on a 5" X 8" index card; the teacher initiates the task when the student demonstrates mastery of the technique or process. If there are six tasks or centers available in the classroom, perhaps completion of *five* would earn an "A," four a "B," three a "C," etc.

2. The jury is another way to assess learning. Students, teachers, other adults, or any combination thereof will constitute the evaluating team. The jury hears the student tape and evaluates it, using specific criteria.

3. Create a three-minute synthesized tape composition following these parameters: ABA form; gradual change in amplitude from beginning to end; recurring ostinato pattern throughout; polyphonic texture in "A" sections; monophonic texture in "B" section. A jury may use the following form as criteria for evaluating the composition:

**Jury Evaluation Form**

| | Yes | No |
|---|---|---|
| a) Is the composition three minutes in length? (+/– ten seconds allowed) | _____ | _____ |
| b) Is it written in discernible ABA form? | _____ | _____ |
| c) Does it employ gradual amplitude change? | _____ | _____ |
| d) Is ostinato pattern used throughout? | _____ | _____ |
| e) Is section A polyphonic? | _____ | _____ |

f) Is section $A_1$ polyphonic? _____ _____

g) Is section B homophonic? _____ _____

h) Is the quality of the recording clear? _____ _____

i) Is silence used as a compositional tool? _____ _____

j) Is the work interesting to the ear? _____ _____

Most effective/strongest part: _____ _____

Least effective/weakest part: _____ _____

Comments: _____

Name of Reviewer: _____

Date: _____

## IV. HISTORY AND LITERATURE OF ELECTRONIC MUSIC: A SUGGESTED UNIT

**INSTRUCTIONAL OBJECTIVE:** *The student should be able to identify representative stylistic characteristics and compositional techniques associated with the history and literature of electronic music.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- compare and contrast stylistic differences between *musique concrete* and "pure" electronic music composition
- identify with accuracy the titles and composers of six representative works from the literature of electronic music
- associate nine electronic music terms with nine recorded electronic music examples. The terms are:

| | |
|---|---|
| sine wave | white noise |
| theremin | glissando |
| feedback | musique concrete |
| sawtooth wave | tape loop |
| ostinato | |

- identify ten European and American composers who have used the medium of electronic music

**History and Literature of Electronic Music**

A. The History of Electronic Music

1. Early Developments

The origin of electronic music can be traced to the invention of the electronic vacuum tube in 1906 by Lee DeForest. He called his invention the Audion. Also developed that year was a 200-ton studio instrument called the Dynamophone. Sounds were produced using a series of huge dynamos as tone generators. The inventor, Thaddeus Cahill, transmitted the signals over telephone lines to audiences up to 100 miles away from the laboratory.

Later in the 1920's, other experimental instruments were created including the Theremin, the Sphaerophon, the Ondes Martinot, and the Trautonium. The Theremin is still used as an electronic instrument in the 1970's. However, it was not until the development of the magnetic tape recorder after World War II that electronic music could develop into a viable art form.

2. Music Studios

The first major electronic music studio was established in 1948 in Paris by Pierre Schaeffer. He presented his first work, "Railroad Study," in May of that same year. Although Schaeffer's early experiments were not especially musical in nature, in 1949 he collaborated with composer Pierre Henry in a novel form of sound composition called *musique concrete*. This new music involved the electronic processing of sounds collected from natural and/or created sources. In 1951, Radiodiffusion Francaise organized the Group de Recherches (Research Group on Concrete Music) and provided them with a fully equipped studio. The function of the group at the present time is to create music for film, television, radio, and the theater.

A Cologne radio station introduced its listeners to electronic music in 1951 through a forum conducted by Werner Meyer-Appler, Robert Beyer, and Herbert Einhart. This feature led to the subsequent development of an electronic music studio at the station. Over the years, the focus of this studio has been pure electronic sound generation, and it has become a model for the purists in the field. Perhaps the most famous composer-in-residence at the Cologne studio has been Karlheinz Stockhausen, who began working there in 1953.

Other studios throughout the world include those in Tokyo (1951) by Sony and by Toshiro Mayuzumi (1955); Rome (1957); Warsaw (1957); Brussels (1950); Delft (1957); Israel (1957); Russia (1958); and Toronto (1959).

3. Developments in the United States

Early experiments in the United States included efforts by John Cage in 1951 and Vladimir Ussachevsky and Otto Luening in 1952. It was Ussachevsky and Luening, both music professors at Columbia University, who explored the many possibilities available to them at that time. They made their results available to the public through seminars (Bennington Composers Forum); concerts (Museum of Modern Art, New York, 1952); and on Dave Garroway's "Today" television show.

By 1955, several private electronic music studios had been established; however, the universities were not yet interested in exploring the genre. During this time, Ussachevsky and Luening directed their efforts toward establishing a studio at Columbia University. When they joined forces with Milton Babbitt at Princeton University and with RCA (developers of the Mark II Synthesizer), the Columbia-Princeton Electronic Music Center (CPEMC) became a reality. The initial concerts of the Center were given in May 1961. The Center, located on the Columbia University campus, is considered to be the best equipped and largest electronic music center in the world.

The 1960's saw a proliferation of electronic music studios through the world. In 1968 approximately 100 studios existed, more than half of them in American and Canadian colleges and universities. Commercial electronic instruments were appearing on the market and instruction was beginning in the public schools. By 1970, the three most famous electronic music laboratories on the American continent were located at the University of Illinois, at Columbia University, and at the University of Toronto. By 1975, nearly all institutions of higher learning had studios of various sizes, and approximately five percent of the high schools in this country had synthesizers available to them.

B. The Literature of Electronic Music

Although a variety of commercial recordings and tapes are available for presenting a survey of electronic music literature, the excellent recordings and texts for Macmillan's *Electronic Music* (1975) and Silver Burdett's *New Music: Electronic Music* (1976) are available to MCPS staff and may be borrowed through the Department of Educational Media and Technology, Educational Services Center.

A suggestion would be to use five individual selections from the Macmillan and Silver Burdett recordings. These would represent five important milestones in the development of the literature and would also be used as the basis for stylistic comparison. The five selections could be presented over several class periods or could be augmented with other sources to span a period of several weeks.

Here are the five milestones, each with a representative recording and each with a brief discussion regarding its importance to the development of the genre.

1. *Musique Concrete* — 1950

   a) Background

   A new world of possibilities was opened to the composer through the use of the tape recorder and through its potential for manipulation and alteration of sound. Natural sounds such as dripping water could be collected, organized, and combined into interesting compositions. The French composer Pierre Schaeffer created the title *musique concrete*, meaning music produced from "concrete" or environmental sources. The first public performance of *musique concrete* took place in Paris in 1950.

   b) Recording

   Oliver Messiaen: *Festival of Beautiful Waters* (Macmillan). Other composers who contributed to the European impetus of *musique concrete* include Boulez, Pousseur, and Stockhausen.

2. American "Tape Recorder" Music — 1952

   a) Background

   Although *musique concrete* was a uniquely European creation, American composers were also involved in the style. The first public performance of American *musique concrete* tape recorder compositions took place on October 28, 1952 in the Museum of Modern Art in New York City. The main compositional technique during this era was to alter and distort conventional sound sources through speed change, change of tape direction, filtering, etc.

   b) Recordings

   Otto Luening: *Fantasy in Space* (Silver Burdett)
   Vladimir Ussachevsky: *Sonic Contours* (Silver Burdett)
   LeCaine: *Dripsody* (Silver Burdett)

3. The Era of the Electronic Synthesizer

   a) Background

   The next step was for compositions to be created entirely from sounds generated or "synthesized" by electronic means. Private and industrial research centers assisted in the development of devices designed to generate a wide spectrum of sounds. Various foundations also provided supports for research and development.

   A major public awakening came about in 1958 when Edgar Varese's *Poeme Electronique* was presented to more than three million individuals attending the Brussels Exposition. This eight-minute, pure electronic work sounded through 400 speakers and was accompanied by a series of projected visuals. Many attacked the work, saying it was not music. Varese called it "organized sound."

   b) Recordings

   Edgar Varese: *Poeme Electronique* (Macmillan)
   Raaijmakers: *Contrasts, Part 2* (Silver Burdett)

4. Electronic Sound Combined with Traditional Instruments

   a) Background

      A natural evolution from pure electronic music was for composers to write works employing conventional instruments performing with recorded electronic sound.

      In 1961, Otto Luening presented *Gargoyles for Violin Solo and Synthesizer*. This approach to composition helped to mollify those critics who claimed that electronic music was strictly a "canned" art form.

      Recent developments in technology have greatly expanded the live performance capability of the synthesizer. The impact of this advance has been felt especially in the field of popular music.

   b) Recording

      Otto Luening: *Gargoyles* ([excerpt] Macmillan)
      Walter Carlos: *Variations for Flute and Electronic Sounds* (Silver Burdett)

5. Use of Biofeedback and Computers

   a) Background

      Some composers are presently using biofeedback machines and computers programmed to create music or to generate musical ideas in combination with a synthesizer.

      Milton Babbitt has programmed a computer to create musical ideas. These ideas are transmitted to a synthesizer, thus transferring them into organized sound.

   b) Recording

      Milton Babbitt: *Composition for Synthesizer* (Silver Burdett)

C. Sample Assessment Items:

1. Discuss electronic music composers active in the 1950's, and compare the contributions of each.

2. Discuss four tape techniques used by LeCaine in the preparation of "Dripsody."

3. Name one of the "classic" electronic music recordings discussed in class. Give the composer and approximate time of composition. Tell your reactions to listening to the work and give reasons why you like or dislike the composition.

4. Write a 200- to 500-word report on a significant composer of electronic music. The report should include such things as a list of compositions, biographical information, materials, equipment and technique used, and important contributions.

5. Name and briefly describe three experimental electronic instruments developed prior to 1940.

6. Listen to *Contrasts, Part 2* (Silver Burdett) by Raaijmakers. Listen to the work again — this time listening for the following:

   a) What is the *form* of the work? (ABA form)

b) What kind of sound appears in all but one part of the work? (white noise)

c) In what part *doesn't* it appear? (coda)

7. Listen to Carlos' *Variations for Flute and Electronic Sounds* (Silver Burdett). This is a theme played by the flute and followed by six variations.

Respond to the following by circling the correct word or phrase:

Variation 1:

The electronic accompaniment is:
active  little motion or movement

Variation 2:

Do you hear:
one flute  two flutes

Variation 3:

Is there a solo instrument?
yes  no

Variation 4:

What best describes the only other sound besides the solo flute?
sine wave  white noise flourish

Variation 5:

Do you hear:
electronic sounds alone
flute sounds alone
both alternating

Variation 6:

Electronic sounds begin with what duration of notes?
long  short

## APPENDIX

The following are instructional objectives and sample performance objectives for Electronic Music II. A listing of suggested strategies, materials, and assessment measures will be compiled at some future time.

### Electronic Music II

**INSTRUCTIONAL OBJECTIVE 1:** *Students should be able to demonstrate the skills and competencies acquired from their experience in Electronic Music I.*

**SAMPLE PERFORMANCE OBJECTIVE (See Electronic Music I)**

**INSTRUCTIONAL OBJECTIVE 2:** *Students should be able to demonstrate the use of a variety of electronic music notational systems.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- describe and record elements of sound including amplitude, timbre, and time by means of graphic or pictorial representation
- replicate a composed work, using only the graphic or pictorial notation

**INSTRUCTIONAL OBJECTIVE 3:** *Students should be able to demonstrate the facility to create extended sound compositions, using a variety of formal design structures.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- demonstrate the skill of using additive form as the structural basis for a ten-minute composition
- demonstrate the skill of using a modified sonata-allegro form as the structural basis for a five-minute composition

**INSTRUCTIONAL OBJECTIVE 4:** *Students should be able to demonstrate a knowledge of significant trends in the history and literature of electronic music, based on extensive research.*

**SAMPLE PERFORMANCE OBJECTIVE**

Students will:

- compare and contrast the field of electronic music in the contemporary rock and roll ensemble with that of electronic music created in the studio by "serious" composers
- identify new technological advances made in the field of synthesizer design
- create program notes for their own compositions
- demonstrate their critical skills by reviewing and evaluating compositions by peers

**INSTRUCTIONAL OBJECTIVE 5:** *Students should be able to create descriptive sound compositions such as radio and television jingles, background music for film, and music to accompany school dramatic productions.*

**SAMPLE PERFORMANCE OBJECTIVES**

Students will:

- replicate the sound track of six electronic radio or television commercials and discuss the technique used for each

- create a catalog of patches for descriptive sounds such as locomotive, bells, wind, sea, siren, etc.

## GLOSSARY OF ELECTRONIC MUSIC TERMS

**ACOUSTICS** ..... The study of production, transmission, and reception of sounds

**ADDITIVE SYNTHESIS**..... Combining waveforms to create new waveforms

**ALTERNATING CURRENT (AC)** ... A flow of electricity which reaches maximum in one direction, decreases to zero, then reverses itself and reaches maximum in the opposite direction

**AMBIENT NOISE**..... Sounds that are part of, and natural to, a recording environment

**AMPLIFIER**..... A device used to increase the power, voltage, or current of a signal

**AMPLIFY**..... To increase the amplitude (loudness) of a signal

**AMPLITUDE**..... Loudness — refers to the maximum value of power, voltage, or current during a single cycle of a wave

**AMPLITUDE MODULATION (AM)**. The periodic variation of a signal's amplitude, or the process by which this is achieved

**ATTACK**..... The beginning envelope phase of a sound as it rises to maximum amplitude

**ATTENUATE**..... To reduce the amplitude (loudness) of a signal (opposite of AMPLIFY)

**ATTENUATOR**..... A device used to reduce the amplitude (loudness) of a signal

**AUDIO** ..... Within the audible range

**AUDIO GENERATOR** ..... An electronic device which produces complex signals at frequencies within the audible range (The terms oscillator and generator are frequently used interchangeably; but in correct usage, oscillator refers to a device that produces sine waveforms, and generator refers to a device that produces complex waveforms.)

**AUDIO OSCILLATOR** ..... An electronic device which produces sinusoidal (sine) signals at audible frequencies (See **AUDIO GENERATOR.**)

**AUDIO SPECTRUM** ..... The entire range of oscillations that can be heard by the human ear (The extreme limits of human hearing are approximately 20-20,000 Hz.)

**BAND-PASS FILTER** ..... A filter that allows a certain band of frequencies to pass, rejecting both high and low frequencies outside the band

**BAND-REJECT FILTER** ..... A filter that rejects a certain band of frequencies, allowing both high and low frequencies outside this band to pass

**BULK ERASER**..... A device that erases an entire reel of tape at one time

**CARRIER**..... In frequency or amplitude modulation, the *audio signal* as opposed to the *modulating signal*

**CENTER FREQUENCY** ..... The average frequency of a band of frequencies

**CHANNEL** ..... A single path of sound that uses electronic equipment to travel from a sound source to a loudspeaker

**CONTACT MICROPHONE**..... A microphone that must be placed in physical contact with the vibrating body in order to transform vibrations into electrical signals

**CROSSTALK**..... Signal leakage from one track to another during tape playback

**CURRENT** ..... The movement of electrons through a conductor

**CUTOFF FREQUENCY** ..... The frequency above which or below which a selective circuit fails to respond

**CYCLE**..... One complete vibration or oscillation of a waveform

**CYCLES PER SECOND (cps)** ..... See HERTZ.

**DECIBEL (db)** ..... The standard unit of loudness

**DECAY** ..... (1) The envelope characteristic having to do with the ending of a sound or signal (2) A small, momentary fall-off from the attack peak

**DIODE**..... A two-terminal device which will conduct electricity more easily in one direction than in the other

**DIRECT CURRENT (DC)** ..... Current which always flows in the same direction

**DIRECT-WIRE RECORDING** ..... Recording from an electronic source rather than a live one (also called *line recording*)

**DUB**..... To make a copy of a recorded tape; or the copy itself

**ENVELOPE GENERATOR** ..... A control-voltage source, used in conjunction with a voltage-controlled amplifier, that shapes a sound envelope by regulating its attack/decay/sustain/release phases

**ECHO**..... A delayed repetition (sometimes several rapid repetitions) of the original sound or signal; the discernible replication of sounds usually at a lower amplitude (See REVERBERATION.)

**EDIT** ..... To select, reject, and arrange into final form, as in preparing a tape composition

**ELECTRON** ..... Tiny atomic particle having a negative electric charge

ELECTRONIC MUSIC ..... Music which utilizes sounds created or altered by electronic means

ENVELOPE ..... Those characteristics having to do with the attack, steady rate, and decay of a sound or signal; the contour of a sound or signal with respect to time (See ATTACK, DECAY, SUSTAIN, RELEASE.)

ERASE HEAD ..... The lead-off head of a tape recorder that erases previously recorded materials on the tape prior to its passing the record head

EVENT ..... The basic element of electronic music, in the form of a taped unit of sound, used as raw materials for musical compositions

FEEDBACK ..... The reaction of the output or part of the output of an amplifying device upon the input to secure either reinforcement (positive feedback) or reduction (negative feedback) of the original input

FILTER ..... A device that permits the selective transmission of certain frequencies of the input signal by the attenuation of undesired frequencies (See BAND, PASS FILTER, BAND-REJECT FILTER.)

FOUR-TRACK RECORDING ..... Recording on which four separate signals or sound paths can be utilized at the same time for recording and playback

FREQUENCY ..... The number of vibrations per second of a signal, designated as cps or Hz. (A signal's frequency usually determines its pitch.)

FREQUENCY MODULATION (FM) .. The periodic variation of signal frequency

FUNDAMENTAL ..... The lowest, or first, partial of a sound's frequency structure

GAIN ..... A quantity expressing the degree of amplification of an amplifier or device (Gain may be positive or negative, although negative gain is usually referred to as loss.)

GATE ..... A device for controlling the amplitude (loudness) of a signal path (Voltage-controlled amplifiers are sometimes called gates.)

GENERATOR ..... See AUDIO GENERATOR.

GLISSANDO ..... A glide; a rapid slide, up or down, through consecutive pitches (See PORTAMENTO.)

HALF-TRACK RECORDING ..... Tape recording done on half the width of the magnetic tape

HARMONIC ..... An overtone or frequency component present in complex sounds, also called a *partial* (The frequency of a harmonic is an integral multiple of the fundamental frequency.)

**HARMONIC SERIES** ..... The natural series of overtones resulting from the vibration of objects at a constant frequency (the fundamental). The harmonics occur at 2, 3, 4, 5, 6, etc., times the fundamental frequency. Their presence or absence, and their relative amplitudes determine the timbre of a tone. Certain waveforms have known harmonic contents, a useful fact for the composer.

**HEADS** ..... Electromagnetic devices which contact the magnetic tape. On tape recorders they serve three functions: erase, record, and playback.

**HERTZ** ..... A term used internationally in place of "cycles-per-second." Hertz (Hz) is derived from the name of the German scientist Heinrich Rudolph Hertz, who was the first to detect, create, and measure electromagnetic waves.

**HIGH-PASS FILTER**..... A filter that subtracts the frequencies below a given cutoff point, and passes those above

**IMPEDANCE**..... The resistance effect of a circuit or component; expressed in ohms

**INPUT** ..... A signal fed into a circuit or device; a jack designed to accept an incoming signal

**INCHES PER SECOND (IPS)**..... Speed at which tape moves past a head of the tape recorder. Most common speeds are 1⅞, 3¾, 7½, and 15 ips.

**JACK** ..... A plug-in terminal to which temporary connections may be made with patch cords. Common types of jacks are: phone, phono, and mini.

**KEYBOARD CONTROLLER** ..... A manual controller for use with synthesizers. Discrete, equally spaced values of control voltage are selected by depressing appropriate key.

**LINE**..... A signal input (line in) or output (line out) for connecting electronic components

**LOW-PASS FILTER** ..... A filter that subtracts the frequencies above a given cutoff point and passes those below

**MAGNETIC TAPE**..... A plastic tape coated with iron oxide and used in magnetic recordings. Only one side of the tape is coated with this magnetically sensitive powder. Standard widths are ⅛ inch for cassettes, and ¼ inch for cartridge and most reel-to-reel tape recorders.

**MIC/LINE** ..... Circuitry which permits the simultaneous use of both a microphone and a line input

**MIL** ..... A unit of measure equal to one-thousandth of an inch; used to gauge tape thickness

MIXER ..... A device for combining several input signals for the purpose of feeding the combined signals to another audio component

MICROPHONE ..... An electroacoustic transducer which responds to sound waves and delivers essentially equivalent electric waves; a device which converts sound into electrical signals

MODULATION ..... The process in which a characteristic of a waveform is (usually) periodically varied (See AMPLITUDE MODULATION, FREQUENCY MODULATION.)

MONITOR ..... A device used for checking audio signals, usually during the recording process

MUSIQUE CONCRETE ..... Music that is constructed from processed recorded sound sources other than those which are purely electronic

NOISE ..... (1) Undesired sound
(2) Sound in which frequency of vibration is unstable (See WHITE NOISE.)

OSCILLATION ..... Vibration

OSCILLATOR ..... (See AUDIO OSCILLATOR and VOLTAGE-CONTROLLED OSCILLATOR.)

OSCILLOSCOPE ..... An instrument that reproduces, on the screen of a cathode-ray tube, a graphic representation of signals in the shape of waveforms; used to determine amplitude, frequency, and other waveform characteristics

OUTPUT ..... The signal that comes out of a circuit or device; a jack designed to accept an out-going signal

OVERDUBBING ..... A process of recording additional sounds with sounds previously recorded

PANNING ..... A recording term used to describe the panoramic movement of sound

PARAMETER ..... A variable quantity that can be measured

PARTIAL ..... See HARMONIC.

PATCH CORD ..... A cord with plugs or jacks at both ends, used to establish a temporary connection, usually between an output and an input

PATCH PANEL ..... A board or panel where circuits are terminated in jacks

PEAK ..... The maximum value of amplitude, or a momentary value considerably higher than the average

PHONE PLUG ..... A large plug, ¼ inch in diameter, used for feeding audio signals to a phone jack; may be in either mono or stereo configuration (also called a telephone plug)

NOTE: Phone Plug is not to be confused with Phono Plug (see below).

PHONO PLUG ..... A small plug used for feeding audio signals to a phono jack. Phono plugs are monophonic and are used in pairs for stereo applications; also called an RCA plug.

PINK NOISE ..... A signal like white noise, except that some of the higher frequencies are filtered out

PORTAMENTO ..... Glide control or glissando; an electronic keyboard control used to regulate varying degrees of glide between pitches

POTENTIOMETER ..... A device used for the precise measurement of voltages by comparison of an unknown voltage with a reference voltage (Abbreviation: "pot"). Often used to denote a volume control on audio equipment.

PRE-AMPLIFIER ..... An electronic device that raises low-level signals to a level usable by other components

PRINT THROUGH ..... Also, layer-to-layer signal transfer. A sound distortion factor caused by the transfer of magnetism from one layer of tape to an adjacent layer while the reel is in storage

PULSE WAVE ..... A rectangular wave, in which the harmonic content varies with the proportion of the rectangle. A pulse wave always contains uneven on-off time segments. A square wave is a pulse wave with equal on-off time.

QUARTER-TRACK RECORDING .. Recording that uses ¼ (rather than ½ or all) the width of the tape for each recording. Stereo ¼ track recording requires simultaneous recording on two of the four tracks.

RCA PLUG ..... (See PHONO PLUG.)

RECORDING HEAD ..... An electromagnetic transducer used to implant magnetized patterns on recording results of such arrangements. On some recorders, the same head can function as a record head or playback head, depending upon which mode is selected.

RELEASE ..... The final envelope phase as amplitude declines to silence. (See DECAY.)

RESONANCE ..... Also *regeneration control.* A filter control used to emphasize the overtones to the cutoff point in order to brighten the sound

REVERBERATION ..... Commonly called *reverb*. Repetitions of sound that are so closely spaced in time that they cannot be distinguished individually. (1) The effect produced by multiple overlapping echoes in a room or concert hall. (2) A repetitive effect artifically produced by an electro-mechanical device. (See ECHO.)

RIBBON CONTROLLER ..... A metal ribbon that produces a varying voltage when a finger is moved along its length

RING MODULATOR ..... An analog multiplier circuit used to combine signals in such a way that the output consists of sums and differences of all the input frequency components

SAMPLER ..... Also *random sampler, sample/hold*. An electronic device that "samples" amplitude levels of a waveform at pre-set time intervals

SAWTOOTH WAVE ..... A signal consisting of a fundamental frequency and all harmonics, with the intensities of the harmonics inversely related to frequency

SEL-SYNC ..... Also *simul-sync*. Electronic circuitry in a tape recorder which permits playback directly from the record head. Designed for monitoring a recorded signal in exact synchronization with a second signal being recorded.

SEQUENCER ..... A device that is used to produce a preset voltage sequence for the purpose of controlling a series of events with voltage-controlled equipment

SIGNAL ..... An electrical current the fluctuations of which correspond to sound vibrations

SIGNAL-TO-NOISE RATIO (SNR) .. A comparative measurement of the signal level in relation to the level of system noise

SIGNAL GENERATOR ..... The source of sound; an oscillator or audio generator or even a tape recorder, in a very general sense

SINE WAVE ..... The waveform corresponding to a single frequency oscillation. The sine wave is a fundamental tone with no harmonics.

SOUND ..... Pressure waves of a frequency audible to the human ear. The properties of sound are frequency, amplitude, duration, and timbre (waveform). When frequency of vibration is regular or stable, pitch results; when unstable, noise results.

SOUND-ON-SOUND ..... A method of recording a second signal on top of a previously recorded track of tape

SOUND-WITH-SOUND ..... A tape recording technique in which a new signal is recorded on one track in synchronization with the signal on a previously recorded track on the same tape

SOUND WAVE ..... The periodic compression and rarefaction of the atmosphere at frequencies discernible to the human ear (BMI 33)

SOURCE ..... The entity that supplies signals; in tape recording, the in-coming signal

SPLICE ..... The connection of two segments of magnetic tape, usually with the help of special splicing tape. The splicing tape is adhered only to the non-magnetized side of the tape.

SPLICING BLOCK ..... Specially designed apparatus to facilitate the accurate cutting and splicing of magnetic tape; also called an *editing block*

SQUARE WAVE ..... A signal consisting of a fundamental frequency and all odd-numbered harmonics, with the intensities of the harmonics inversely related to frequency. The square wave is a pulse wave with equal on-off time.

SUSTAIN ..... A relatively steady state when the sound remains at a certain level of pitch, loudness, or timbre; the intermediate envelope phase of a sound

SYNCHRONIZATION ..... Coordinating, with regard to time, one set of events with another

SYNTHESIZER ..... A system of electronic modules or instruments for the production and control of sound

TAPE DECK ..... A unit which contains the tape transport, heads, and preamplifier

TAPE RECORDER ..... Tape deck with the addition of amplifier and speakers

TAPE LOOP ..... A length of magnetic tape with the ends joined together to form an endless loop; used, through continuous playback, for constant repetitions of sounds recorded on the loop

## ANNOTATED BOOK LIST

Appleton, Jon H., and Perera, Ronald C. (eds). *The Development and Practice of Electronic Music.* Englewood Cliffs, N.J.: Prentice-Hall, 1975.

An invaluable source for teachers involved in electronic music. Six excellent chapters (origins, sound, tape studio, voltage-controlled synthesizer, use of digital computers, and live-electronic music) are independent. Contains detailed bibliography and discography.

Borowicz, John. *Synthesizer Primer.* Vernon, Conn.: Electronic Music Laboratories, Inc., 1974.

An excellent basic handbook suitable for classroom use. Terminology similar to that used with Electro Comp synthesizers.

Crowhurst, Norman H. *Electronic Musical Instruments.* Blue Ridge Summit, Pa.: Tab Books, 1971.

A valuable general reference work.

Dwyer, Terence. *Composing with Tape Recorders.* London: Oxford University Press, 1971.

*Musique concrete* for beginners. An excellent non-technical paperback which contains practical suggestions and examples. Well-organized, with graded activities.

Ernst, David. *Musique Concrete.* Boston: Crescendo Publishers, n.d.

Beginners' handbook on electronic music. One section of the book is devoted to a step-by-step procedure for producing an actual electronic tape composition by using only microphone and tape recorders.

Friend, David; Pearlman, Alan R.; and Piggott, Thomas D. *Learning Music with Synthesizers.* Winona, Minn.: Hal Leonard Publishing Co., 1974.

An extremely valuable "how-to-do" book which is designed for use with the ARP "Odyssey."

Howe, Hubert S., Jr. *Electronic Music Synthesis.* New York: W. W. Norton & Co., Inc., 1975.

An excellent text suitable for college level courses. A valuable reference work.

Marsh, Mary Val, and others. *Electronic Music.* New York: Macmillan Publishing Company, Inc., 1975.

One of the best texts available for getting started with electronic music. Also includes data on how to build your own oscillator.

MENC. *Electronic Music.* Originally published as the November 1968 issue of the *Music Educators Journal.* Music Educators National Conference, 1968.

A *must* for every teacher involved in teaching electronic music. Contains rationale, glossary, equipment lists, discography, interviews, reader reaction, etc. An extremely valuable recording of student electronic music compositions with "scores" accompanies the re-issue. Some material has become dated.

Reimer, Joyce Bogusky. *New Music; Electronic Music.* Morristown, N.J.: Silver Burdett, 1976.

Russcol, Herbert. *The Liberation of Sound: An Introduction to Electronic Music.* Englewood Cliffs, N.J.: Prentice-Hall, Inc. 1972.

Traces the growth and evaluation of electronic music. Discussion of events, literature, and biographical sketches of significant composers. Includes anecdotes, opinions, record reviews, discography, and essays. Invaluable as a reference work. Possible use as a text in classes with emphasis on history/literature.

Sear, Walter. *The New World of Electronic Music.* Port Washington, N.Y.: Alfred Publishing Company, Inc., 1972.

An excellent basic work. Concise, easy to read, and understandable. Suitable as a text.

Strange, Allen. *Electronic Music: Systems, Techniques, and Controls.* Dubuque, Iowa: William C. Brown, 1972.
An excellent work, suitable mainly as a reference. Possible text for an extremely sophisticated class.

Trythall, Gilbert. *Principles and Practice of Electronic Music.* New York: Grosset and Dunlap, 1973.
An excellent fundamental book suitable as text. Contains glossary, scores, explanation of equipment, etc. Also contains suggested instruments and materials for classical studio techniques and recordings.

Willman, Fred. *Electronic Music for Young People.* New York: W. W. Norton & Co., Inc., 1975.
Six detailed lessons adaptable to any age group. Contains selective lists of recordings, periodicals, books, films, filmstrips, and additional enrichment sources.

## ARTICLES ON ELECTRONIC MUSIC

Aranda, William. "Education and Electronic Sound Syntheses — The Quiet Revolution." *Music Educators Journal,* July 1974, p. 94.
Describes the inclusion of electronic music in the modern curriculum and justifies the cost on a per pupil basis.

Carruth, Carroll. "Electronic Music — What Now?" *Instrumentalist,* March 1971, p. 29.
History of electronic music. Use of computers in electronic music.

Easton, John. "A Portable Electronic Instrument." *Music Educators Journal,* October, 1966, p. 54.
Background of Synket.

Ehle, Robert G. "Synthesizers, Anyone?" *Music Educators Journal,* January 1971, p. 78.
Comparison of synthesizers available on the market at that time.

——. "Testing Scales with Moog." *Music Educators Journal,* November 1971, p. 50.
Describes certain electronic techniques which make testing of many scales relatively easy. Moog synthesizer used in description.

——. "The Social World of Electronic Music." *Instrumentalist,* October 1970, p. 36.
Good discussion of electronic music in the world of music, engineering, arts.

——. "The Synthesizer or the Orchestra?" *School Musician,* January, 1972, p. 50.
Describes uses of the synthesizer.

"Electronic Music." Twenty articles on electronic music by various authors. MENC, *Music Educators Journal,* November 1968.
A *must* for anyone serious about teaching electronic music. One hundred-page compendium of electronic music materials.

"Electronic Music: Creative Tool in the Classroom. Part I. Why Get Involved?" *School Musician,* April 1970, p. 58.
Background and creativity guide.

Ernst, David. "So You Can't Afford an Electronic Studio." *Music Educators Journal,* February 1973, p. 45.
Materials list, techniques, short discography, resources list.

Jackson, Hanley. "Electronic Confusion." *Instrumentalist,* September 1971, p. 53.
Background and justification.

Kuchler, Leland F. "Musique Concrete and Aleatory — Two Ways to Recapture Interest." *Music Educators Journal,* February 1973, p. 42.
Justification and techniques.

Lorentzen, Bent. "Electronic Music Means Switched-on Creativity." *Music Educators Journal,* November 1970, p. 56.
Suggested techniques for using electronic music with children.

Mayer, Alfred. "Electronic Music — Like It or Not." *Music Journal.* April 1973, p. 16.
Attempts to justify electronic music for listeners, serious musicians, and composers alike.

Norton, Richard. "The Vision of Morton Subotnick." *Music Educators Journal,* January 1970, p. 35.
Short biographical sketch and ideas of Morton Subotnick.

Siennicki, Edmund J. "An Electronic Music Studio in the Junior High School." *Instrumentalist,* November 1971, p. 47.
How to and why — purposes and goals.

Staub, C. Martin. "Electronic Music in the Classroom." *Music Educators Journal,* June 1970, p. 62.
Definition of subject and classroom techniques given in *musique concrete.*

"The Plugged-In Era, Parts One and Two." *Music Educators Journal,* February and March 1975, p. 21.
Provides in two installments an excellent review of the background and development of electronic music and electronic instruments.

Trythall, Gilbert. "Suggested Instruments and Materials for a Classical Electronic Studio." *Instrumentalist,* June 1974, p. 40.
Includes a list of equipment for a classic studio. Makes no mention of synthesizers, however.

——. "The Tape Recorder in the Electronic Music Studio." *Instrumentalist,* September 1974, p. 58.
Describes in a brief article what type of tape recorder should be chosen for use in a studio. Lists seven guidelines.

Wolf, Gregory. "Some Suggestions on Conducting Herbert Bielaw's 'Spectrum'." *Instrumentalist,* March 1968, p. 85.
"Spectrum" was first published work for prerecorded tape and concert band. Article gives hints for performance.

## RECORDS

AMERICAN METAPHYSICAL CIRCUS. Joseph Byrd and the Field Hippies, Columbia MS7317.

CLOCKWORK ORANGE. Warner Brothers, 2573.
Soundtrack includes music from Beethoven's *Ninth Symphony,* Rossini's *William Tell Overture,* and other works, mostly performed by Walter Carlos on his electronic synthesizer.

COLLAGES, SYMPHONY NO. 3. For Electronic Tape and Orchestra. Roberto Gerhard.
Angel S-36558

COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER. Columbia MS6566
"Stereo Electronic Music No. 1," Bulent Arel
"Leiyla and the Poet," Halim El-Dabh
"Creation-Prologue," Vladimir Ussachevsky
"Composition for Synthesizer," Milton Babbitt
"Electronic Study No. 1," Mario Davidovsky
"Gargoyles," Otto Luening

COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER. CRI S-227
"Concerted Piece for Tape Recorder and Orchestra," Luening and Ussachevsky
"Events M," Powell
"Improvisation," Powell
"Second Electronic Setting," Powell
"Two Prayer Settings," Powell
"Of Wood and Brass," Vladimir Ussachevsky
"Wireless Fantasy," Vladimir Ussachevsky

COUNTRY MOOG (Switched on Nashville), Gilbert Trythall. Athena 6003
Well-done album by a well-known author of electronic music.

EDGAR VARESE. Edgar Varese. Columbia ML5478 and MS6146
"Ionisation"
"Integrales"
"Hyperprism"
"Density 21.5"
"Octandre"
"Poeme Electronique"
Good electronic music by one of the leading pioneers

ELECTRIC TOMMY. Viva V36025
Done on a Putney VCS3 with live guitar and percussion.
Some selections including "Pinball Wizard" are excellent.

ELECTRONIC MUSIC. Folkways Scholastic 33436
"Inferno," Grauer
"Pinball," Ivey
"Collage," Robb
"Dripsody," LaCaine
"Noesis," Atkin
"Fireworks," Stephen
"Summer Idyl," Walter-Olnick
"Dance R4+3," M. Schaeffer
Excellent album of *Musique Concrete*. A *must* for your library.

ELECTRONIC MUSIC. Turnabout (VOX) 34004
"Vocalise," Avni
"Dialogues for Piano and Two Loudspeakers," Carlos
"Variations for Flute and Electronic Sound," Carlos
"Study No. 1," Lewin-Richter
"Tombeau d'Edgar Poe," Mimaroglu
"Intermezzo," Mimaroglu
"Bowery Bum," Mimaroglu

ELECTRONIC MUSIC III. Turnabout (VOX) TV 34177
"Theme (Omaggio a Joyce)," Luciano Berio
"Animus I," Jacob Druckman
"Piano Music for Performer and Composer," Mimaroglu
"Six Preludes for Magnetic Tape," Mimaroglu

ELECTRONIC MUSIC FROM RAZOR BLADES TO MOOG. Asch AHS 3438

ELECTRONICS AND PERCUSSION. Columbia M57139 (Five Realizations by Max Neuhaus)
"The King of Denmark," Morton Feldman
"Four Systems," Earle Brown
"Coeur pour batteur — Positively Yes," Sylvano Bussotti
"Fontana Mix — Feed," John Cage
"No. 9 Zyklus for One Percussionist," Karlheinz Stockhausen

ELECTRONIC MUSIC FROM THE UNIVERSITY OF ILLINOIS. Heliodor HS 25407
"Machine Music," Lejaren Hiller
"Lemon Drops," Kenneth Gaburo
"For Harry," Kenneth Gaburo
"Canto," Charles Hamm
"Futility," Herbert Brun
"Underworld," Savatore Martirano

ELECTRONOMUSIC — 9 IMAGES. John Pfeiffer. RCA VICS1371

EVERYTHING YOU ALWAYS WANTED TO HEAR ON THE MOOG. Columbia M30383
"Espana," Chabrier
"Malaguena," Lecuona
"Prelude to Act I" (*Carmen*), Bizet
"Habanera" *(Carmen),* Bizet
"Introduction to Act I" (*Carmen*), Bizet
"Bolero," Ravel
Excellent electronic rendition of Spanish music.
Even the applause at the end of recording is synthesized.

GERSHWIN ALIVE AND WELL UNDERGROUND. Avco Embassy. AVE 33021
Gershon Kingsley's album of well-done Gershwin representations including "Rhapsody in Blue" and others.

HYMNEN-ANTHEMS FOR ELECTRONIC AND CONCRETE SOUNDS. Karlheinz Stockhausen.
Deutsche Grammophone. SLPM 139421/2
Electronic Music based on national anthems.

I.'S GA FOR GASSED-MASKED POLITICO, HELIUM BOMB, AND TWO-CHANNEL TAPE.
Salvatore Martirano. Polydor 24-50001

LUMPY GRAVY. Frank Zappa. Verve 6-8741

METAMORPHOSIS. Donald Erb. Ars Antigua AN1008
"Kyrie"
"Summermusic"
"Trio for Two"

MOOG: THE ELECTRIC ECLECTICS OF DICK HYMAN. Command 938-S
Contains original music for synthesizer and a variety of other keyboard and rhythm instruments. Light pop music with a jazz influence.

THE MOOG STRIKES BACH. RCA LSC 3125
Imitation of "Switched on Bach" but not as well done.

MORE SWITCHED ON BACHARACH. Decca DL 75243

MUSIC OF EDGAR VARESE, COL. 2, Edgar Varese, Columbia ML5762 and MS6362
"Deserts"
"Offrandes"
"Arcana"
Good early electronic music by one of the leading pioneers.

NASHVILLE GOLD, Gilbert Trythall. Athena 6004

THE NONESUCH GUIDE TO ELECTRONIC MUSIC. Nonesuch HC-73018
Stereo 2-record set and booklet by Paul Beaver.
Recorded examples of synthesizer sounds. Includes score and recording of *Peace Three*, and excellent original work for Moog Synthesizer.

PICTURES AT AN EXHIBITION. Emerson, Lake, and Palmer. Cotillion Records ELP 66666.
Live performance recording. Includes guitar, percussion, along with electronic synthesizer. A recording students can readily identify with.

PICTURES AT AN EXHIBITION. Tomita. RCA Red Seal ARLI 0838 stereo.
An excellent electronic version of Mussorgsky's classic.
Highly recommended.

POEME ELECTRONIQUE. Edgar Varese. Columbia MS 6146
A classic in its field. A *must* for any record library.

PROZESSION FOR TAMTAM, VIOLA, ELEKTRONIUM, PIANO, FILTERS, AND POTENTIOMETERS. 1967. Karlheinz Stockhausen, Candide CE 31001. With booklet.

QUARTERMASS. Tod Dockstader. Owl ORLPS.

QUARTET, STRINGS, AND ELECTRONIC TAPE, NO. 3. Leon Kirchner. Beaux Arts Quartet Columbia MS7284.

RIP, RAG, AND PANIC. Roland Kirk. Limelight 86027.

THE SCIENCE OF SOUND. Folkways FX6007.

1. How We Hear
2. Frequency
3. Pitch
4. Vibration & Resonance
5. Intensity
6. Loudness
7. Noise Measurement
8. Masking
9. Echo & Reverberation
10. Delay Distortion
11. Fundamentals and Overtones
12. Quality
13. Subjective Tones
14. Music and Noise
15. Filtered Music & Speech
16. Dissonance & Consonance
17. Music Scales
18. Vibrato and Tremolo
19. The Doppler Effect

SGT. PEPPER'S LONELY HEARTS CLUB BAND. The Beatles. Capitol SMAS2653.
Contains excellent early examples of use of tape technique in pop/rock music.

SILVER APPLES OF THE MOON. Morton Subotnick. Nonesuch H-71174.
Realized on Buchla synthesizer. One of the classics of electronic music.

SING ME A SONG OF SONGMY: A FANTASY FOR ELECTROMAGNETIC TAPE. Ilhan Mimaroglu. Atlantic SD1576.
Freddie Hubbard and his quintet with reciters, chorus, string orchestra, Hammond organ, synthesized and processed sounds.

SNOWFLAKES ARE FALLING. Tomita. RCA Red Seal ARL 1-0488 stereo.
Music of Debussy realized on the Moog by a well-known Japanese composer. Highly recommended.

SOUNDS OF NEW MUSIC. Folkways FX 6160.

STOCKHAUSEN: ELECTRONIC MUSIC. Deutsche Grammophon 138811.

SWITCHED ON BACH. Walter Carlos. Columbia MS7184.
The classic! A *must* for any library!

SWITCHED IN ROCK: THE MOOG MACHINE. Columbia CS9921.

THE WILD BULL. Morton Subotnick. Nonesuch H-71208

TIME'S ENCOMIUM: For Synthesized and Processed Synthesized Sound. Nonesuch H-71225.
Pulitzer Prize winner by Charles Wuorinen.

UMMAGUMMA. Pink Floyd. Capitol STBB-388.
An excellent recording by a popular English rock group. Many excellent examples of electronic techniques are included. Highly recommended for high school use.

UNITED STATES OF AMERICA. Columbia CS9614

VOICE OF THE COMPUTER. Decca DL710810

WELL TEMPERED SYNTHESIZER. Walter Carlos. Columbia MS7286
Carlos' second recording. Most critics agree a better effort than "Switched on Bach."

WE'RE ONLY IN IT FOR THE MONEY. The Mothers of Invention. Verve 65045

Each film comes with a synopsis and suggestions for teaching techniques. These suggestions, questions for discussion, and vocabulary can be put to very effective use by the teacher.

Teachers are urged to watch for new films dealing with electronic music which will be placed in the MCPS film library in the future.

## FILMS

*Electronics: An Introduction* (F5656-BFA 1972, I, J, S. 10 minutes. Color)
Describes the diode vacuum tube, conductor, electric light, bulb, amplifier, and the transistor as electronic devices. Uses an electronic music background.

*New Sounds in Music* (F4787 — Churchill 1969, J. S. 22 minutes. Color)
Presents new musical sounds and ways of treating old sounds. Includes examples of chance music, tape music, synthesizer music, and other twentieth century innovations. Accompanied by 10" L. P. recording which supplies additional listening material for classroom use.

*Discovering Electronic Music* (F5078 — Baily 1970, P. J. S. 23 minutes. Color)
Shows something of the physical basis of music and how it can be created and altered by electronic means.

*Between the Tides* (F2782 — Contemporary 1959, J. S. 22 minutes. Color)
This is a marine biology film; uses electronic music as background.

*To Be a Composer* (F4789 — Churchill Films. JH, SH, C. 25 minutes. Color)
A documentary film on the contemporary composer Lalo Schifrin. In additional to traditional compositional techniques, Mr. Schifrin explores the use of electronic and environmental sounds.

## A-V KITS

*Creating Music Through the Use of the Tape Recorder* by Anne D. Modugno.
© Keyboard Junior Publications, Inc.
Filmstrip with teacher's guide and student booklets; 18 programmed lessons dealing with tape techniques.

*Electronic Music* (two parts, narrated by Milton Babbitt)
© 1972 Educational Audio Visual, Inc.
2 filmstrips. 2 records, teacher's guide.
Suggest for senior high electronic music classes.

*Famous Musicians at Work*. Morton Subotnick (Set One) and Otto Luening (Set Three).
© 1970 Schloat Productions, Inc. (Prentice-Hall)
4 filmstrips. 4 records each.

*How To Make Electronic Music* by Anne D. Modugno, Russell Drake, and Ronald Herder.
© E. A. V., Incorporated
4 filmstrips, 4 records, 10 student handbooks, $88.50

*Listening to New Music*
© E. A. V., Incorporated
2 filmstrips, 2 records (or cassettes)
Photographs, example of musical notation, and recorded works of Milton Babbitt, John Cage, Jacob Druckman, Harvey Sollberger, and Hugo Weisgall

*Pathways to Music — Electronic Music* by Nick Rossi
© 1971 Keyboard Junior Publications, Inc.
2 filmstrips, 2 records, 8 study prints for board display, teacher's guide.
Excellent. Recommended for any class embarking on a study of electronic music.

## RECOMMENDED EQUIPMENT AND SUPPLIES

### EQUIPMENT

1. Tape recorders should have the following characteristics:

   a) reel-to-reel stereo
   b) two or more speeds
   c) high fidelity record and playback quality
   d) three-head design (separate erase, record, and playback heads)
   e) pause control (heads activated in pause function desirable)
   f) easy access to tape heads
   g) separate VUE-meters for each channel
   h) half-track stereo is ideal; quarter-track and quad units are acceptable
   i) equipped with good quality recording microphones

A minimum of two stereo tape recorders is recommended for each electronic music lab. Additional recorders (cassette, monophonic reel-to-reel, field tape recorders, etc.) are very helpful, especially in large classes.

2. Modular Electronic Sound Units

   At this writing, modular units appear to be impractical for general classroom use. An exception might be where the students build their own modules. Desirable characteristics of modular units can be found in *Principles and Practice of Electronic Music* by Gilbert Trythall.

3. Synthesizers

   Salient features of six popular synthesizers can be found in *The New World of Electronic Music* by Walter Sear. The following synthesizers have been used with success in MCPS classroom situations:

| | |
|---|---|
| Electro-Comp Model 101 | ARP Odyssey |
| Electro-Comp Model 200 | ARP 2600 |
| Electro-Comp Model 500 | |

### SUPPLIES

Check the warehouse catalog for availability of the following supplies:

| | |
|---|---|
| 08-31-107 | Tape (recording, 7″ reel, 1200 per reel) |
| 08-31-110 | Tape (recording reel 7″ empty, plastic) |
| 08-31-191 | Tape (Cassette, audio, 90 minute) |
| 08-31-193 | Tape (cassette, audio, 60 minute) |
| 12-51-220 | Labels (pressure sensitive, white, ⅛″ X 1″, 1000 per pkg.) |
| 12-51-332 | Tape (mending, transparent, non-glossy, ⅛″ X 1206″, 1 inch core) |
| | Tape (leader, white, 1200″ reel) |
| | Tape (tail, red, 1200″ reel) |
| | Edital splicing kit (aluminum) KS-3 |
| | Extra CX1 splicing tabs, box |

The audiovisual aide in each school is a good resource for supplies and equipment such as tape recorders, microphones, adaptors, patch cords, etc. Other supplies such as headphones, headphone box, sound sources, rulers, grease pencils, etc. should be secured as needed.